



Minor Change to the On-Post Record of Decision for RCRA-Equivalent Soil Covers, Rocky Mountain Arsenal

Fact Sheet

April 26, 2007

Purpose of the Fact Sheet

The purpose of this fact sheet is to document minor changes to the requirements of the Record of Decision (ROD) for the On-Post Operable Unit (OU) for the Rocky Mountain Arsenal (RMA) related to the design and construction of soil covers. Requirements for the soil covers for the Basin A, South Plants Central Processing Area (CPA), Section 36 Lime Basins, Former Basin F and Complex Army Trenches projects have been revised based on information developed during the remedy process. Details related to these design changes are included in remedial design documents, including the Integrated Cover System Design (ICSD) and Basin F/Basin F Exterior Part 2 (Basin F Cover) Design. The ICSD is a combined design for all covers within and near Section 36 including Basin A, South Plants, Complex Army Trenches, and Section 36 Lime Basins projects. When finished, the ICS will be a continuous cover system, which includes the Shell Disposal Trenches RCRA-equivalent cover. Although both designs have been previously issued, they are being revised to capture changes discussed in this fact sheet. The ICSD was made available for public comment at the 95 percent design stage on April 3, 2007. The Basin F Cover Design will also be made available for public comment later in 2007 upon completion of the 95 percent design package. The Shell Disposal Trenches, which also requires a RCRA-equivalent soil cover, is documented in a separate design package (TtEC 2006b). Changes from the ROD for the Shell Disposal Trenches cover are documented in an Explanation of Significant Differences (ESD) (TtEC 2006a).

Remediation Framework

The ROD was signed by the U.S. Army (Army), the U.S. Environmental Protection Agency (EPA) and the Colorado Department of Public Health and Environment (CDPHE) on June 11, 1996, with concurrence of the U.S. Fish and Wildlife Service (USFWS) and Shell Oil Company (Shell). The Army, serving as the lead agency, and Shell are implementing the selected remedy that includes 31 implementation projects for soils, structures, and the treatment of groundwater contaminants (PMRMA 2005). The EPA, CDPHE and the Tri-County Health Department are conducting regulatory oversight. Tetra Tech ECI serves as the Program Management Contractor and selects the subcontractors needed to perform remediation tasks.

Currently, RMA is completing an environmental cleanup of the site's soil, structures and groundwater. Once cleanup is complete, RMA's vast open spaces will constitute one of the nation's largest urban wildlife refuges. To date, approximately 80 percent of the RMA has been certified as clean by the EPA and removed from the National Priorities List (NPL). As land is

removed from the NPL, it is transferred from the Army to the USFWS for inclusion into the national wildlife refuge system. By fall 2006, more than 12,000 acres joined the refuge system and these land transfers have established and expanded the RMA National Wildlife Refuge. After the Arsenal's remaining cleanup projects are complete and removed from the NPL, the Army will transfer an additional 2,800 acres to the USFWS to further expand the Refuge. By 2011, the cleanup program will be finished and the Army will retain approximately 1,100 acres to maintain its groundwater treatment plants, landfills and soil covers (including Basin A, South Plants, Section 36 Lime Basins, Complex Army Trenches, Basin F, Shell Disposal Trenches and Shell Trenches 2-foot soil cover area).

Summary of Site History and Contamination Issues

The RMA is a federally owned facility located in Commerce City, Colorado, approximately 10 miles northeast of downtown Denver. In 1942, at the height of World War II, the Army purchased 17,000 acres of land on which to manufacture chemical weapons, such as mustard gas, white phosphorus and napalm to be used as a deterrent during wartime efforts. To foster economic growth in the area, offset operational costs and maintain the facilities for national security, private industry was encouraged to lease facilities at the Arsenal after the war. Under the lease program, Julius Hyman and Company began producing pesticides in 1946. Shell Chemical Company acquired Julius Hyman and Company and continued to produce agricultural pesticides on site until 1982. Common industrial and waste disposal practices during those years resulted in contamination of structures, soil, surface water, and groundwater. Currently, the RMA On-Post OU site encompasses approximately 5.5 square miles and is on the EPA NPL for environmental cleanup as a result of contamination released during previous RMA operations.

In 1984, the Army began a systematic investigation of site contamination in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), and the site was placed on the NPL in 1987. The NPL is a list of the nation's most contaminated sites, also known as Superfund sites. As required by CERCLA, a Remedial Investigation (RI) was conducted to determine the nature and extent of contamination. The RI identified contaminated soils and waste materials in manufacturing and disposal areas including Basin A, South Plants CPA and the Complex Army Trenches. The primary contaminants in these areas are pesticides, solvents, heavy metals and chemical agent by-products.

Basin A is centrally located in Section 36 on the RMA. During the 1940s and 1950s, aqueous industrial wastes from South Plants and North Plants were routinely discharged into unlined evaporation basins, including Basin A. Use of Basin A for liquid disposal was discontinued in 1956 when chemical sewers were constructed to convey waste to Basin F. The Basin A cover area encompasses approximately 147 acres. The Complex Army Trenches are located east of Basin A in central Section 36. The Complex Army Trenches were the primary solid waste disposal area for the Army from the early 1940s through the late 1960s. Those solid wastes included miscellaneous solid chemical waste and potentially contaminated tools and equipment, unwanted containers, rejected incendiaries, empty munitions casing, and rejected munitions. The Complex Army Trenches cover area encompasses approximately 91 acres. Figure 1 shows the location of the Basin A and Complex Army Trenches cover areas.

The South Plants area, located in the south-central portion of the RMA in Section 1, was a chemical manufacturing complex designed, built, and used by the Army from 1942 through 1982. During these years, the Army manufactured chemical agents, prepared and filled incendiary munitions, intermittently demilitarized phosgene and mustard munitions, and blended

rocket fuel. Beginning in 1947, portions of South Plants CPA were leased to private industry for production of pesticides and other chemicals. In 1952, Shell Chemical Company (which later

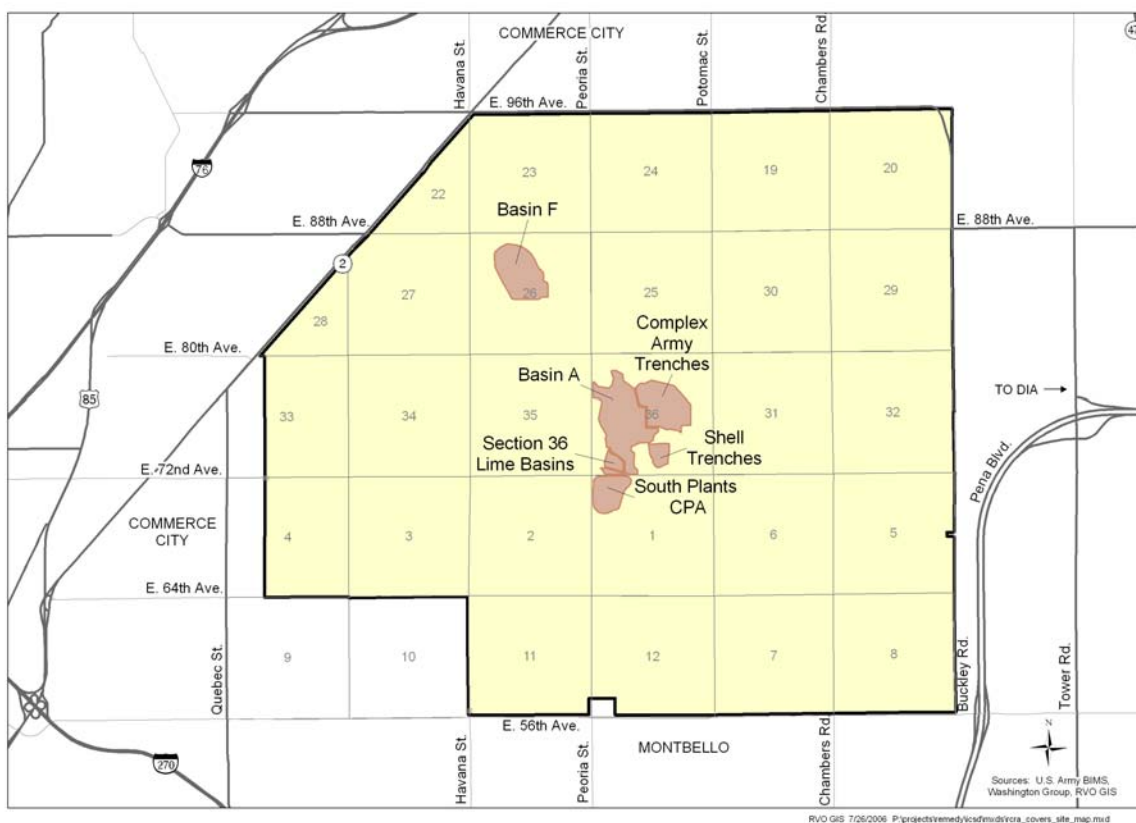


Figure 1 Location of RMA RCRA-Equivalent Covers

became Shell Oil Company) became the primary commercial manufacturer at the South Plants until 1982, producing herbicides, insecticides and pesticides. Liquid waste from South Plants was originally disposed in Basin A and later, through the chemical sewer system, to Basin F. The South Plants CPA cover area encompasses approximately 47 acres. Figure 1 shows the location of the South Plants CPA cover area.

The Section 36 Lime Basins are located just north of 7th Avenue in the southwestern portion of Section 36. Three unlined basins, each approximately one acre in size, were constructed in 1942 and were designed to remove arsenic from South Plants wastewater and to receive other aqueous waste from South Plants. Through 1943, wastewater from production of Lewisite was routinely treated with lime prior to discharge to the basins. The lime was used to precipitate metals and reduce arsenic concentration in the wastewater, resulting in a lime sludge that contained high levels of heavy metals, including arsenic. After Lewisite production ceased in November 1943, the Lime Basins continued to receive other liquid waste from South Plants from both Army and Shell production activities, including pesticide production wastewater. These wastes were transported through two chemical sewers that discharged into the south side of the basins. Wastewater from the Lime Basins was subsequently discharged to Basin A. Wastewater disposal to the Lime Basins ceased in January 1957 following the completion of the chemical sewer lines to Basin F. In 1993, an Interim Response Action (IRA) was completed to mitigate potential

contaminant migration, resulting in construction of a soil vegetative cover over the Lime Basins area. Figure 1 shows the location of the Section 36 Lime Basins cover area.

Former Basin F is located in the north central portion of Section 26 on the RMA as shown on Figure 1. Basin F was constructed in 1956 by building a dike around a natural depression, lining the basin with a 3/8-inch asphalt membrane and placing approximately one foot of soil on top of the asphalt membrane to protect it. Basin F had a surface area of 92.7 acres and a capacity of approximately 243 million gallons. The impoundment was used between 1956 and 1982 to contain liquid wastes from both Army and Shell chemical operations. Liquid waste from South Plants and North Plants was disposed through the chemical sewer system to Basin F where it was allowed to evaporate. Soil beneath Basin F was contaminated by wastewater that infiltrated through the liner during Basin F operations. All waste discharged to Basin F was terminated in December 1981 and the basin was preliminarily closed by the removal of all conveyance systems into the basin by July 1982. In 1988 and 1989, an IRA was conducted to address concerns regarding liquid and soil contamination in and under Basin F. The IRA included removal of remaining liquid from the basin and subsequent treatment by submerged quench incineration, removal of contaminated soil and sludge and disposal in the Basin F Wastepile, and construction of an 18-inch thick soil cover over the basin.

Explanation of Minor Changes to ROD Requirements

The following sections describe changes to the ROD requirements for Resource Conservation and Recovery Act (RCRA)-equivalent soil covers. Project-specific changes are discussed first followed by general RCRA-equivalent cover design changes. A summary of these changes is presented in Table 1.

Basin A and South Plants Central Processing Area Soil Cover Design

The ROD has specific requirements for Basin A and the South Plants CPA that include construction of a four-foot-thick soil/vegetation layer (soil cover) to isolate underlying waste remaining in place (FWENC 1996). The covers are required to minimize infiltration of water through the cover into the remaining waste and underlying soil.

Although the ROD included RCRA-equivalent covers for three other projects (Former Basin F, Shell Disposal Trenches and Complex Army Trenches), the Basin A and South Plants CPA projects did not require this type of cover to achieve adequate isolation of waste and provide protection of human health and the environment. During the Basin A design, preliminary information available from the RMA's on-site RCRA-Equivalent Cover Demonstration Project was reviewed for consideration of specific soil types that would be suitable for the Basin A cover construction to minimize infiltration. As a result, the Basin A design included specific information on the soil types for cover construction that are similar to the suitable soil types for RCRA-equivalent covers (RVO 1997a).

Similarly, the South Plants CPA design process included specific soil type information to meet the objective of minimizing water infiltration through the cover (FWENC 2001). An ESD was completed describing changes to the soil cover (FWENC 2000), and included a requirement for the South Plants CPA soil cover to be designed and constructed using the same criteria that were used to build the RCRA-equivalent test covers. Following completion of the South Plants design, additional discussions with the federal, state and local Regulatory Agencies resulted in a decision to upgrade both the South Plants CPA and Basin A soil covers to RCRA-equivalent covers, maximizing the long-term protectiveness for the waste containment areas (RVO 2002).

Compared to a standard RCRA Subtitle C cover, which relies on a barrier system comprised of compacted clay and plastic liners, a RCRA-equivalent cover uses an alternative design to achieve the same performance standards described in RCRA. The RCRA Subtitle C requirements are the most rigorous environmental regulations for ensuring that wastes are properly contained. Like a standard RCRA cover, the alternative cover is sloped to promote precipitation runoff; however, the RCRA-equivalent cover relies on a thick soil layer (minimum 42 inch thickness) and native vegetation to further limit infiltration through the cover. The soil layer acts like a sponge, holding moisture from precipitation. The moisture then evaporates from the soil surface and/or transpires through the vegetation. This combined process, or evapotranspiration, moves moisture up instead of down and naturally limits percolation. Figure 2 illustrates the typical construction for RMA RCRA-equivalent covers.

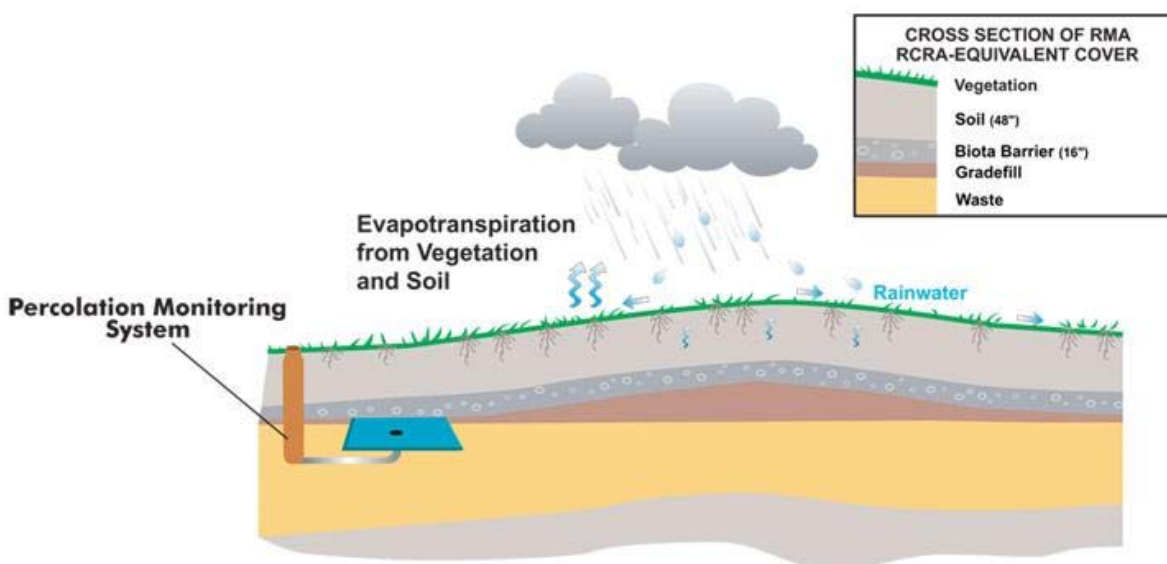


Figure 2 Cross Section of RMA RCRA-Equivalent Cover

The change from non-RCRA-equivalent to RCRA-equivalent covers requires several changes to the projects. The primary change is the compliance standard for percolation of water through the covers. The RMA's RCRA-Equivalent Cover Demonstration Project established a performance standard for percolation of no more than 1.3 mm/year (RVO 1998). In order to provide cover compliance monitoring, cover construction will include a measurement tool (percolation monitoring pans known as lysimeters) to measure water percolation below the soil covers.

The change to RCRA-equivalent covers also requires the application of more stringent soil type requirements for construction. Following the completion of the RCRA-Equivalent Cover Demonstration Project field demonstration, an evaluation was conducted to establish design criteria for the full-scale RCRA-equivalent cover implementation projects. An assessment of the test cover soils used in the field demonstration and further evaluation of soil properties were conducted to ensure that the full-scale cover soil material and placement specifications would result in cover performance equal to or better than that achieved in the field demonstration. As a result, specific criteria for soil textures were created (TtFW 2005c). Construction of RCRA-equivalent covers will use these criteria in selecting the appropriate soils for the covers.

In addition, the change to RCRA-equivalent covers requires more rigorous quality assurance (QA) and quality control (QC) testing for construction, including independent Professional

Engineer certification by a Construction Quality Assurance Engineer. Although the original designs required QA/QC testing to meet construction requirements, the change to RCRA-equivalent covers results in an increase in testing frequency to better ensure that acceptable soils are used. In addition, the final designs require testing of the cover soils after construction to ensure that design specifications are met.

South Plants Central Processing Area Cover Area

Liquid waste and potentially contaminated storm water from South Plants were conveyed through sewers for disposal in the Section 36 Lime Basins, Basin A and Basin F. Releases from these sewer lines resulted in soil contamination above the cleanup criteria identified in the ROD. Chemical and storm water sewers immediately north of the CPA in Section 36, as well as contaminated soils associated with these lines, were identified for cleanup under the Section 36 Balance of Areas Soil Remediation Project.

During excavation of the sewers and contaminated soil, strong chemical odors were observed emanating from the excavations. In addition, results of confirmatory and further investigation samples indicated the presence of additional contamination exceeding the ROD criteria at several locations, contrary to the RI and design sample results. Based on these field observations, the remedy was modified to include removal of the additional identified contaminated soil and the South Plants CPA RCRA-equivalent cover was extended to include the former chemical sewer area in Section 36 between the CPA and the Section 36 Lime Basins (TtFW 2005a). The additional cover area is approximately six acres, increasing the total South Plants CPA RCRA-equivalent cover area to approximately 53 acres, a 13 percent increase. The addition of this cover area will result in a continuous RCRA-equivalent cover area between South Plants CPA, Section 36 Lime Basins and Basin A.

Basin A and Complex Army Trenches Human/Wildlife Barrier

The ROD includes standards for the Basin A and the Complex Army Trenches projects to prevent wildlife and human contact with underlying contaminated soil and potential disposed munitions by using wildlife barriers and maintaining institutional controls, such as site access restrictions. To meet this standard, the ROD requirements for Basin A and the Complex Army Trenches include a six-inch-thick layer of concrete for a human/wildlife barrier.

During the Basin A design, possible alternatives for the human/wildlife barrier design that could be applied site-wide for all RMA cover projects requiring this barrier were evaluated. The Basin A Design Analysis included an evaluation of four alternatives including the ROD-described six-inch-thick solid concrete layer. The evaluation focused on design criteria, cost and advantages/disadvantages for each alternative.

The conclusions reached in the Basin A design included a recommendation for an 18-inch-thick crushed concrete barrier to serve as the human/wildlife barrier (RVO 1997b). Based on discussions with the USFWS, an 18-inch-thick crushed concrete barrier would be more effective in limiting intrusion by burrowing mammals than the six-inch-thick solid concrete layer. In addition, the crushed concrete barrier was less costly than the six-inch-thick layer and there was an available source of crushed concrete at the Stapleton Redevelopment located near the site. Also, the proximity of the material minimizes the transportation impact on surrounding communities. The design analysis also included a recommendation to provide a 50-foot minimum extension of the barrier around the perimeter of the covers, reducing the potential for burrowing animals to burrow around and under the edges of the wildlife barrier. These

recommendations were intended to apply to the Basin A and Complex Army Trenches projects as well as other RCRA-equivalent cover projects at RMA. Also, the Basin A design dispute resolution included a provision for high visibility warning tags (later changed to tape) within the cover soil to provide an additional layer of subsurface warning to humans.

The recommendations developed during the design process for Basin A were reviewed during finalization of the ICSD to address concerns over quantity of available concrete at the Stapleton Redevelopment site and the overall cost of cover construction. As a result, the wildlife barrier was revised to a minimum 16-inch thickness of crushed concrete, which remains sufficient to function as a suitable wildlife barrier. Also, to minimize the potential for wildlife intrusion through the void spaces in the crushed concrete barrier, the final design includes a provision that placement of the concrete be completed such that there are no continuous two-inch voids through the full thickness of the crushed concrete layer.

RCRA-Equivalent Cover Design

Consistent with final design discussions, cover projects with an assumed 12-inch-thick wildlife barrier in the ROD have been modified to include the 16-inch-thick barrier with the 50-foot minimum extension. This includes the South Plants CPA and Former Basin F, as well as the cover designs for the on-site landfills and the Section 36 Lime Basins. In the case of the Lime Basins, a ROD Amendment completed in 2005 (TtEC 2005) changed the remedy for the Lime Basins to include a RCRA-equivalent cover. The ROD Amendment specified an 18-inch-thick wildlife barrier consistent with the Basin A recommendations. The ICSD, which includes the Lime Basins cover construction, modifies the barrier thickness to be consistent with the final barrier thickness criteria.

Several other minor design changes have been developed during the various cover design projects. These changes apply to all projects with a RCRA-equivalent soil cover component.

The ROD standards for RCRA-equivalent covers include:

Allow no greater range of infiltration through the cap than the range of infiltration that would pass through an EPA-approved RCRA cap.

However, the ROD did not specify a compliance threshold or indicate requirements for measurement of this standard. The RMA's RCRA-Equivalent Cover Demonstration Project established a performance standard for percolation of no more than 1.3 mm/year (RVO 1998), which was approved by federal, state and local regulatory agencies. In order to provide cover compliance monitoring, RCRA-equivalent cover construction includes lysimeters to measure water percolation below the soil covers.

During the RCRA-Equivalent Cover Demonstration Project, it was determined that during relatively wet weather periods, an additional impediment to percolation, referred to as a capillary break, was forming at the bottom of the test covers due to the contrast in pore size between the finer-grained cover soils and the underlying geotextile (a coarser material) that was placed as part of a geocomposite drainage system to collect and measure percolation. Further data review from the demonstration project led to the conclusion that the combination of the cover soils and the capillary break in the test covers was sufficient to meet the 1.3 mm/year percolation standard. Consistent with subsequent laboratory testing, the capillary break design selected for use in the RCRA-equivalent covers incorporates a geotextile between the fine-grained cover soil and the coarse wildlife barrier surface to enhance the performance of the capillary break (TtFW 2005b).

The high visibility warning tape recommended during the Basin A design was eliminated in favor of high visibility (orange) geotextile. The geotextile, added to enhance the performance of the capillary break, provides a subsurface warning to humans and eliminates the need for the warning tape layer within the cover soil. Also, during design, a concern was identified for geotextile placement directly over the crushed concrete barrier. Therefore a bedding soil layer overlying the wildlife barrier was added to the cover design. The bedding soil will fill voids in the surface of the crushed concrete barrier layer and provide a relatively smooth surface for placement of the geotextile.

Table 1: Summary of Changes to RCRA-Equivalent Soil Cover Projects

Project	Changes from ROD
Basin A	Change 4-foot-thick soil cover to RCRA-equivalent soil cover. Change 6-inch concrete barrier to minimum 16-inch-thick crushed concrete barrier.
South Plants CPA	Change 4-foot-thick soil cover to RCRA-equivalent soil cover. Change 12-inch-thick crushed concrete to minimum 16-inch-thick crushed concrete barrier. Extend cover over former chemical sewer area in Section 36.
Complex Army Trenches	Change 6-inch concrete barrier to minimum 16-inch-thick crushed concrete barrier.
Former Basin F	Change 12-inch-thick crushed concrete to minimum 16-inch-thick crushed concrete barrier.
Section 36 Lime Basins ¹	Change 18-inch-thick crushed concrete to minimum 16-inch-thick crushed concrete barrier. Eliminate chokestone layer.
Common Elements	Add lysimeters for percolation compliance monitoring. Include 50-ft extension of concrete barrier around each cover. Include a soil leveling layer above the wildlife barrier to provide an even surface for placement of the geotextile. Add geotextile between cover soil and soil leveling layer/concrete barrier to enhance the performance of the capillary break. In addition, use orange colored geotextile to serve as an additional warning against human intrusion.

¹Changes listed are from ROD Amendment (TtEC 2005).

Public Participation

Presentations explaining each remedial design are provided to the Arsenal's Restoration Advisory Board (RAB). The RAB is a community group that meets regularly to receive information and provide input on the cleanup. These meetings are open to the public. A presentation for the 95 percent ICSD was provided to the RAB in April, 2007. A similar presentation will be conducted for the Basin F Cover design when completed. The Army, in consultation with the EPA and the State of Colorado, will evaluate comments received before issuing a final remedial design.

The design packages, and all documents that support the changes described here, are part of the Administrative Record and are available at the Joint Administrative Record and Document Facility (JARDF) and the EPA Region 8 Superfund Records Center. The JARDF can be reached

at 303-289-0362. Hours of operation are Monday through Friday, 12 p.m. to 4 p.m., or by appointment. EPA's Superfund Record Center can be reached at 303-312-6473. Hours of operation are Monday through Friday from 8 a.m. to 4:00 p.m.

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Document Locations

- Joint Administrative Record and Document Facility (JARDF)
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Commerce City, Colorado 80022
Monday – Friday 12 – 4 p.m. or by appointment (303) 289-0362
- EPA Superfund Records Center
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References

FWENC (Foster Wheeler Environmental Corporation)

- 2001 (June 5) *South Plants Balance of Areas and Central Processing Area Soil Remediation Project – Phase 2. 100 Percent Design Package.*
Revision 0. (2v.)
- 2000 (Oct. 23) *Explanation of Significant Differences for South Plants Balance of Areas and Central Processing Area Soil Remediation Project.*
- 1996 (June 11) *Record of Decision for the On-Post Operable Unit.* Version 3.1. (3v.)

PMRMA (Program Manager for Rocky Mountain Arsenal)

- 2005 (Nov.) *Remediation Design and Implementation Schedule.*

RVO (Remediation Venture Office)

- 2002 (Mar.) *Resolution Agreement South Plants Central Processing Area Soil Remediation Project.*
- 1998 (July 1) *Agreement Summary on Comparative Analysis and Field Demonstration Design Scope of Work for the Rocky Mountain Arsenal Resource Conservation and Recovery Act (RCRA)-Equivalent Cover Demonstration Project.*
- 1997a (Sept. 29) *Basin A Consolidation and Remediation Project final Design Package. Revision 0.*
- 1997b (Sept.) *Biota Barriers for Cap and Cover Systems.*

TtEC (Tetra Tech EC, Inc.)

- 2006a (May 5) *Explanation of Significant Differences for the Shell Disposal Trenches Remediation Project. Revision 0.*
- 2006b (May 4) *Shell Disposal Trenches Remediation Project RCRA-Equivalent Cover Construction, 100 Percent Design Package. Revision 1.*
- 2005 (Oct. 20) *Amendment to the Record of Decision for the On-Post Operable Unit, Rocky Mountain Arsenal Federal Facility Site, Section 36 Lime Basins Remediation, Basin F Principal Threat Soil Remediation. Revision 0.*

TtFW (Tetra Tech FW, Inc.)

- 2005a (Feb. 22) *Decision Document DD-S36BOA-01. Design Change Notice for Section 36 Balance of Areas Soil Remediation Project. DCN-BOA-044.*
- 2005b (Feb. 14) *Final Capillary Break Test Report. Revision 0.*
- 2005c (Feb. 11) *RCRA-Equivalent Cover Post-Demonstration Geotechnical Evaluation Final Summary Report for Acceptance Zone Development and Density Requirements for RCRA-Equivalent Cover Soils. Revision 0.*